

# The Effect of Walking Exercise on Physical Fitness and Serum Lipids in Obese Middle-aged Women: Pilot Study

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**Abstract.** [Purpose] This study was conducted to identify the effects of walking on the body composition, health-related physical fitness, and serum lipids as part of efforts to encourage middle-aged people to participate in walking as a regular and sustainable exercise. [Methods] This study was conducted as a pretest-posttest control group study. The study period was for 12 weeks from January to March 2010. The participants were 43 middle-aged women (age range: 40–55 years) with body fat rates over 30%. Subjects in the experiment group participated in the walking exercise (n = 38), the control group did not participate in the exercise (n = 23). [Results] In the exercise group, statistically significant reductions in weight and body fat were observed among the body composition measurement variables, and statistically significant increases in flexibility and cardiopulmonary endurance were observed among the physical fitness measurement variables. TC, TG, and LDL-C levels in the serum lipid measurement variables showed a statistically significant reduction in the exercise group. [Conclusion] The results of this study showed that 12 weeks of walking exercise influenced middle-aged women in a positive way by effecting changes in their body composition, physical fitness, and serum lipids. We believe that these positive changes result in positive effects on the factors for prevention of various adult diseases that can occur in middle-aged women.

**Key words:** Walking exercise, Physical fitness, Middle-aged women

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## INTRODUCTION

The decreases in the fertile and pregnant populations and birth rate have accelerated the aging of Korean society, resulting in an increase in the elderly population. With the increase in the elderly population, increased attention should be given to the middle-aged population, which includes people in the stage prior to the old age<sup>1)</sup>.

Physical, psychological, and mental factors of middle age directly or indirectly affect the quality of life in old age. Unhealthy middle age is the precedent step to unhealthy old age. Improperly managed middle age can cause unexpected unhappiness in old age. Therefore, a healthy old age life can stem from a well-managed and balanced middle age life. Moreover, health in middle age is being emphasized in South Korea aging society.

Middle-aged women experience gradual weakening of physical functions with aging and show decreased physical activities. This decrease increases the obesity rate, causing

middle-aged women to be susceptible to various musculoskeletal problems such as osteoporosis and other degenerative diseases<sup>2)</sup>. Moreover, postmenopausal middle-aged women have reduced ovary functions due to estrogen deficiency, and the level of low-density lipoprotein cholesterol (LDL-C) in the blood increases due to reduced estrogen stimulation and low-density lipoprotein (LDL) receptor activities. In addition, they are susceptible to adult diseases such as coronary diseases because of a rapid increase in the lipid concentration in the blood and subsequent decrease in the high-density lipoprotein-cholesterol (HDL-C) concentration<sup>3)</sup>.

Regular aerobic exercises are suggested for middle-aged and older women to help them overcome their physical and physiological changes and stabilize their mental and psychological status through participation in society activities<sup>4)</sup>. Among the aerobic exercises, walking is the most popular physical activity, and it can be done easily without the use of any devices. Physical and physiological improvements through walking exercise have been shown in a number of studies, and positive influences are observed in most cases. Hence, walking can be an effective exercise from the perspective of preventive medicine. Yet studies on the effects of walking on blood and physical factors in obese middle-aged women have not been conducted sufficiently<sup>5)</sup>.

This study was conducted to identify the effects of walk-

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ing on the body composition, health-related physical fitness, and serum lipids as part of efforts to encourage middle-aged people to participate in walking as a regular and sustainable exercise.

## SUBJECTS AND METHODS

This study was conducted as a pretest-posttest control group study. The study period was for 12 weeks from January to March 2010. The participants were 43 middle-aged women (age range: 40–55 years) residing in Seoul, Korea, with body fat rates over 30%. Subjects in the experiment group participated in the walking exercise ( $n = 38$ ), whereas the control group did not participate in the exercise ( $n = 23$ ). The participants had not undergone any exercise regimen within the previous 1 year. Subjects who could not undergo the exercise tests because of cardiac infarction and pulmonary embolism, confirmed using a self-answered questionnaire, were excluded. This study was approved by the Seodaemun District Office and the institution in which it was performed and complied with the ethical standards of the Declaration of Helsinki. All participants provided their written informed consent to participate in this study prior to enrollment. General characteristics of the subjects are shown in Table 1.

This study evaluated the body composition, physical fitness, and serum lipid level. Body composition was evaluated by measuring body weight, muscle mass, and body mass index (BMI). Physical fitness was evaluated by measuring muscle strength, flexibility, muscle endurance, and cardiopulmonary endurance. Muscle strength was determined by measuring the maximum grip strength by using the dominant hand (pf/kg). Flexibility was measured by a sit-and-reach, in which the subject sat with the knees completely straight and reached forward slowly using both the hands together (unit: cm). Muscle endurance was measured through and exercise test using sit-ups, and the maximum number

was recorded for 30 s after a beep (unit: number). Cardiopulmonary endurance was measured using a treadmill and a gas analyzer (QMC 5000, USA). The Bruce protocol was used for the exercise test, and the maximum exercise point of the participant was set at the maximum heart rate and a respiratory exchange rate of over 1.15 for each age range. The indicator for cardiopulmonary endurance was the point where oxygen intake did not increase even with an increase in exercise intensity. For serum lipid test, the participants fasted from 10:00 (am) of the previous day, and 5 mL of blood was collected from the brachial vein the following day between 08:00 and 10:00 am. After blood collection, the vials were centrifuged, and TC, TG, HDL-C, and LDL-C levels were analyzed in the hemanalysis department.

The walking program was designed such that the number of calories burned was gradually increased to 150 kcal/hr by reducing the weight and increasing the walking speed. The initial exercise duration was 20 min, which was gradually increased to 40–55 min; the initial frequency was 3 times a week, which was increased to 5 times a week. Details of the walking durations and frequencies are shown in Table 2.

Statistical analyses were performed using SPSS/PC ver. 12.0. Two-way repeated ANOVA was used to observe the differences in each measurement factor by group (exercise and control groups) and measurement period (before and after the 24-week walking exercise program participation). A paired *t* test was conducted to confirm the significance of the measured categories of before and after intervention in each group, and all statistical significance ( $\alpha$ ) was set at  $p < 0.05$ .

## RESULTS

Regarding the changes in body composition, weight significantly decreased in the exercise group ( $p < 0.05$ ). No main effect was observed by group (exercise and control groups); however, main and interaction effects ( $p < 0.05$ ) were observed by period (before and after 12 weeks) and period and group (period\*group). Muscle mass significantly decreased in the exercise group ( $p < 0.05$ ). No main effect was observed by group (exercise and control groups); however, main and interaction effects ( $p < 0.05$ ) were observed by period (before and after 12 weeks) and period and group (period\*group). Body fat significantly decreased in the exercise group ( $p < 0.05$ ). Further, main and interaction effects were observed by group (exercise and control groups), period, and period\*group (Table 3).

Regarding changes in physical fitness, no significant change was observed in grip strength (dominant hand) in the exercise and control groups ( $p > 0.05$ ). Further, no main

**Table 1.** General characteristics of the participants

	Exercise group ( $n=38$ )	Control group ( $n=23$ )
Age (year)	46.8 $\pm$ 3.1	46.7 $\pm$ 2.8
Height (cm)	159.1 $\pm$ 3.7	157.4 $\pm$ 4.6
Weight (kg)	58.6 $\pm$ 8.7	56.4 $\pm$ 9.0
Blood pressure		
Systolic (mmHg)	124.0 $\pm$ 14.2	117.7 $\pm$ 9.5
Diastolic (mmHg)	78.0 $\pm$ 11.4	73.40 $\pm$ 9.1

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

**Table 2.** Twelve-week walking exercise program

Period	Intensity	Duration (break)	Frequency
0–3 weeks	100 kcal/h	20 min/2–3 times (5 min)	3 times/week
4–9 weeks	120 kcal/h	30 min/2–3 times (5 min)	4 times/week
10–12 weeks	150 kcal/h	40 min/2 times (5 min)	5 times/week

and interaction effects ( $p > 0.05$ ) were observed by group, period, and period\*group. No significant change was observed with regard to performance of sit-ups in the exercise and control groups ( $p > 0.05$ ); however, partial improvements were observed in the exercise group. Further, no main and interaction effects were observed by group, period, and period\*group ( $p > 0.05$ ), (Table 4).

Regarding changes in serum lipids, TC showed a significant decrease in the exercise group ( $p < 0.05$ ), and main and interaction effects ( $p < 0.05$ ) were observed by group, period, and period\*group. TG showed a significant decrease in the exercise group ( $p < 0.05$ ), and main and interaction effects were observed by group, period, and period\*group ( $p < 0.05$ ). HDL-C showed a significant change in the exercise and control groups ( $p > 0.05$ ), but main and interaction effects were not observed by group, period, and period\*group ( $p > 0.05$ ). LDL-C showed a significant decrease in the exercise group ( $p < 0.05$ ), and main and interaction effects were observed by group, period, and period\*group ( $p < 0.05$ ) (Table 5).

## DISCUSSION

Regular aerobic exercise in middle age increases the metabolic rate and improves risk factors such as obesity, hypertension, and hyperlipidemia. In addition, the functioning of the heart and blood vessels improves so cardiovascular diseases such as coronary diseases are prevented or delayed, thereby preventing various health problems in middle-aged women<sup>6, 7</sup>. The study results showed a significant decrease in weight and body fat in the exercise group that participated in the 12-weeks of walking exercise.

In the study by Nindal et al. (2000), weight and body fat were significantly decreased as a result of 24 weeks of aerobic exercise 5 times a week<sup>8</sup>. Jang (2009) reported that the weight, body fat, and muscle mass decreased significantly in middle-aged women who participated in boxing aerobics<sup>9</sup>. In the studies of Park (2009) and Park (2011) on body composition, significant decreases in weight and body fat were shown, which implies that aerobic exercise and walking affects the body composition of participants<sup>5, 10</sup>. This result is considered to be due to the high breakdown rate of lipids through exercise; lipid usage is increased through an oxidation process, resulting in the reduction of weight and body fat<sup>11, 12</sup>.

Cholesterol (TC, HDL-C, and LDL-C) is a serum lipid found in the blood along with neutral fat and phospholipids. An increase in serum lipids expedites arteriosclerosis and is one of the main reasons for cardiovascular diseases<sup>13</sup>. In particular, this lipid is a risk factor for adult diseases in middle-aged women having reduced female hormone levels and physical fitness because of decreased physical activities caused by aging. Significant decreases in TC, TG, and LDL-C levels and an increase in HDL-C level, although not significant, were observed after the 12-week walking program in this study.

In the study of Ju (2010) on the influence of a 12-week-walking Pilates program in middle-aged women, the serum lipid, TC, TG, and LDL-C levels reduced significantly, and

the HDL-C showed no significant increase<sup>14</sup>. On the other hand, in the study Kim (2009), significant decreases in TC, TG and LDL-C and significant increases in HDL-C levels were observed in obese women after a 24-week walking with running exercise program<sup>15</sup>. We assume that a significant increase in HDL-C was not observed in this study because of a difference in the exercise period and intensity. Both this study and the study of Ju (2010) were conducted for 12 weeks, whereas the study of Kim (2009) was for 24 weeks and was a combination program of walking and running exercises<sup>15</sup>. Thus, tHDL-C might have increased be-

**Table 3.** Changes in body composition

Item	Group	Pretest	Posttest
Weight (kg)	Exercise	58.5±8.6	57.2±7.3***†††
	Control	56.4±9.0	56.6±9.1
Muscle mass (kg)	Exercise	37.3±4.0	38.0±3.8
	Control	36.7±4.4	36.7±4.3
Body fat (%)	Exercise	32.5±3.6	25.5±4.5***†††
	Control	31.2±3.7	31.0±3.6

p value of paired t-test: \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

p value of two-way ANOVA test (period\*group): † $p < 0.05$ ; †† $p < 0.01$ ; ††† $p < 0.001$

**Table 4.** Changes in physical fitness

Item	Group	Pretest	Posttest
Grip strength	Exercise	27.7±3.7	27.1±4.8
	Control	27.95±4.1	27.7±5.9
Sit-and-reach	Exercise	15.4±6.6	16.8±5.6***††
	Control	15.6±4.6	15.5±5.6
Sit-up	Exercise	8.6±4.3	9.1±3.9
	Control	8.5±4.4	8.8±4.3
VO <sub>2</sub> Max	Exercise	24.4±3.5	26.9±4.6***†††
	Control	24.9±4.6	24.7±3.1

p value of paired t-test: \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

p value of two-way ANOVA test (period\*group): † $p < 0.05$ ; †† $p < 0.01$ ; ††† $p < 0.001$

**Table 5.** Changes in serum lipid

Item	Group	Pretest	Posttest
Total cholesterol (mg/dl)	Exercise	212.2±32.2	176.7±29.1****†††
	Control	209.7±34.4	209.0±32.7
Triglyceride (mg/dl)	Exercise	183.2±58.8	138.8±40.0****†††
	Control	185.3±45.8	187.5±46.1
HDL-C (mg/dl)	Exercise	56.5±17.4	55.6±16.1
	Control	60.8±16.4	61.1±16.6
LDL-C (mg/dl)	Exercise	128.0±16.9	111.3±12.0****†††
	Control	130.1±20.0	129.8±16.6

p value of paired t-test: \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

p value of two-way ANOVA test (period\*group): † $p < 0.05$ ; †† $p < 0.01$ ; ††† $p < 0.001$

cause of high-intensity exercises and exercising for long periods. Therefore, further studies are required to assess differences in these factors.

Generally, significant changes in serum lipid levels are observed because aerobic exercise blocks the LDL-C from accumulating on the arterial walls and facilitates the TC removal mechanism in various cells, including smooth muscles in arteries, through increased HDL-C levels, anti-arteriosclerosis, and catabolism during the transport of cholesterol to the liver. The results of this study could be interpreted as a proof of this theory<sup>16)</sup>.

## REFERENCES

- 1) 2012 Year, Aged Population Statistics. Korean National Statistical Office, 2012.
- 2) Wilmore JH, Costill DL: Physiology of Sport and Exercise. New York: Human Kinetics Publisher, 2004, pp 234–245.
- 3) Poehlman ET, Tchernof A: Traversing the menopause: changes in energy expenditure and body composition. *Coron Artery Dis*, 1998, 9: 799–803. [[Medline](#)] [[CrossRef](#)]
- 4) American College of Sports Medicine (ACSM): Guidelines for exercise testing and prescription- New York: Lippincott Williams &Wilkins, 2000.
- 5) Park SY: Influences of walking exercise on health related physical fitness and isokinetic muscular function in obese middle-aged women. Department of Physical Education, Graduate School of Chosun University, 2009.
- 6) Hur S: The effects of step aerobic exercise on cardiovascular disease risk factors and inflammation markers in obese middle-aged women. *Journal of Korean physical education association for women*, 2010, 24: 39–48.
- 7) Nelson ME, Rejeski WJ, Blair SN, et al.: Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc*, 2007, 39: 1435–1445. [[Medline](#)] [[CrossRef](#)]
- 8) Nindl BC, Harman EA, Gotshalk LA, et al.: Regional body composition change in women after 6 months of periodized physical training. *J Appl Physiol*, 2000, 88: 2251–2259. [[Medline](#)]
- 9) Jang SA, Kim SS: Effect of boxing aerobic dance on body composition, blood component and vascular compliance in obese middle aged women. *Journal of the Korea Academia-Industrial cooperation. Society*, 2012, 13: 4009–4017.
- 10) Park DN: The effect of 12 week walking exercise on body composition, physical fitness, metabolic syndrome and immune function in obese women. Department of Physical Education, Graduate School of Chonnam National University, 2011.
- 11) Horowitz JF: Fatty acid mobilization from adipose tissue during exercise. *Trends Endocrinol Metab*, 2003, 14: 386–392. [[Medline](#)] [[CrossRef](#)]
- 12) Hunter GR, McCarthy JP, Bamman MM: Effects of resistance training on older adults. *Sports Med*, 2004, 34: 329–348. [[Medline](#)] [[CrossRef](#)]
- 13) Lee JI: Effects of walking exercise intensities on fatigue, serum lipids and immune function among middle-aged women. *Taeahan Kanho Hakhoe Chi*, 2006, 36: 94–102. [[Medline](#)]
- 14) Ju HJ: Effects of working pilates sports on the body composition and blood lipid of middle age women. Department of Physical Education, Graduate School of Pukyong National University, 2009.
- 15) Kim JA: The Effects of walking, running and dance sports on health related physical fitness blood lipid in obese middle-aged women. Department of Physical Education, Graduate School of Chosun University, 2009.
- 16) Blacher J, Asmar R, Djane S, et al.: Aortic pulse wave velocity as a marker of cardiovascular risk in hypertensive patients. *Hypertension*, 1999, 33: 1111–1117. [[Medline](#)] [[CrossRef](#)]